

REMARKS

Claims 23 and 24 are cancelled. Claims 15-22 and 35-41 are pending in the application.

Claims 15-22 and 35-41 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over a combination of Mathews, U.S. Patent No. 5,658,829 and either Allen, U.S. Patent No. 5,970,373 or Donohoe, U.S. Patent No. 6,093,655; or over the combination of Mathews and Allen or Donohoe in further view of one or more of Sharan, U.S. Patent No. 5,747,166; Brown, U.S. Patent No. 5,780,359; and Nagashima, U.S. Patent No. 5,129,958. The Examiner is reminded by direction to MPEP § 2143 that a proper obviousness rejection has the following three requirements: 1) there must be some suggestion or motivation to modify or combine reference teachings; 2) there must be a reasonable expectation of success; and 3) the combined references must teach or suggest all of the claim limitations. Claims 15-22 and 35-41 are allowable over the various cited combinations of Mathews, Allen, Donohoe, Sharan, Brown and Nagashima for at least the reason that the references, individually or as combined, fail to disclose or suggest each and every element in any of those claims, and fail to provide a basis for a reasonable expectation of success.

Independent claim 15 recites a plasma etching process where a plasma is generated from a gas having active components consisting of one or more of O₂, O₃, H₂ and NH₃. Claim 15 specifically recites that the plasma is oxygen-comprising and is utilized to remove a residue from an outwardly exposed conductive silicon-comprising material at a base of an opening. Mathews discloses removal of a resist material using O₂ etching and a dry physical argon etch to produce faceted sidewalls at an upper surface of an opening

(col. 3, ll. 43-64). Such disclosure does not teach or suggest the claim 15 recited removal of a residue from an outwardly exposed conductive silicon-comprising material at a base of an opening, or the recited removal of such material utilizing plasma generated from a gas having active components consisting of one or more of O₂, O₃, H₂ and NH₃. Nor does the Mathews disclosure of forming faceted sidewalls at an upper surface of an opening utilizing oxygen etch and dry physical argon etch, provide a basis of reasonable expectation of achieving the recited removal of a residue from an exposed conductive silicon-comprising material at a base of an opening with the recited oxygen-comprising plasma.

The Examiner indicates reliance upon Allen as disclosing an oxygen-comprising plasma for removal of residual matter. However, applicant notes that Allen specifically indicates removal of a polymer material 44 from a surface of a nitride material 38 utilizing an O₂ or O₃ plasma ash (Figs. 7-8 and the accompanying text at col. 5, ll. 53-67). Such disclosure does not teach or suggest the claim 15 recited removal of a residue from an outwardly exposed conductive silicon-comprising material at a base of an opening. Further, in combination with Mathews, the removal of polymer from a nitride material disclosed by Allen does not contribute toward suggesting a plasma generated from a gas having active components consisting of one or more of O₂, O₃, H₂ and NH₃ for removal of residue from an outwardly exposed conductive silicon-comprising material at a base of an opening. Nor does the Allen disclosure of removal of polymer from a nitride material contribute toward providing a reasonable expectation of achieving the claim 15 recited removal of a residue from an outwardly exposed conductive silicon-comprising material at a base of an opening using the recited plasma.

With respect to Donohoe, applicant notes that Donohoe qualifies as prior art only 35 U.S.C. § 102(e) and was commonly owned with the present application at the time of the invention. Accordingly, Donohoe is not available as a basis of a § 103 rejection of the present claims.

At page 5 of the present Action, the Examiner indicates reliance upon Sharan as disclosing exposing monocrystalline silicon and as disclosing removal of an unwanted material utilizing a hydrogen plasma. However, the hydrogen plasma disclosed by Sharan does not teach, suggest or contribute toward suggesting the oxygen-comprising plasma recited in claim 15 or utilization of such plasma for removing residual material from an outwardly exposed conductive silicon-comprising material at a base of an opening. Accordingly, the combination of Mathews, Allen and Sharan does not disclose or suggest each and every element recited in claim 15. Further, the utilization of a H₂ plasma as disclosed in Sharan does not contribute toward providing a reasonable expectation of achieving the claim 15 recited removal of residue utilizing the recited oxygen-comprising plasma. Claim 15 is therefore not rendered obvious by the combination of Mathews, Allen and Sharan.

As indicated in the present Action, Brown is relied upon as disclosing various processing temperatures, and Nagashima is relied upon as disclosing utilization of NH₃ and hydrogen as a reducing gas. However, the temperature disclosed by Brown and the utilization of NH₃ and hydrogen as reducing agents as disclosed by Nagashima does not contribute toward suggesting the claim 15 recited use of an oxygen-comprising plasma generated from one or more of O₂, O₃, H₂ and NH₃ or the use of such plasma for removing residue from the base of an opening where the base comprises outwardly exposed

conductive silicon-comprising material. Accordingly, independent claim 15 is allowable over the various cited combinations of Mathews, Allen, Sharan, Brown and Nagashima.

Dependent claims 16-22 are allowable over the various cited combinations of Mathews, Allen, Sharan, Brown and Nagashima for at least the reason that they depend from allowable base claim 15.

Independent claim 35 recites plasma etching utilizing a plasma generated from a gas having active components consisting of one or more of O₂, O₃, H₂ and NH₃. Claim 35 additionally recites utilizing such plasma to etch a carbon-containing polymer from a monocrystalline silicon substrate material at a base of an opening substantially selectively relative to BPSG and monocrystalline silicon. As indicated above, Mathews discloses forming facets in an upper surface of an opening, and does not disclose or suggest removal of material from a base of an opening using the recited plasma. Sharan specifically indicates utilizing argon, H₂, a mixture of H₂ and argon or NF₃ for removing "a thin layer of oxide" within a contact opening. The indication of removal of oxide material as disclosed by Sharan does not disclose, suggest or contribute toward suggesting the claim 35 recited removal of carbon containing polymer residue from a monocrystalline silicon material utilizing the recited plasma. Nor does the combination of Mathews and Sharan provide a basis for a reasonable expectation of the claim 35 recited removal of the carbon containing polymer substantially selectively relative to BPSG and monocrystalline silicon substrate.

As indicated above, Allen specifically indicates removal of a polymer material from a nitride surface. The disclosed removal of material from a nitride surface does not disclose, suggest or contribute toward suggesting the claim 35 recited removal of carbon-containing

polymer from a monocrystalline silicon substrate material, or provide a reasonable expectation of achieving substantial selective removal utilizing the recited plasma. Accordingly, claim 35 is not rendered obvious by the combination of Mathews, Allen and Sharan.

Neither the Brown disclosure of various processing temperature or the Nagashima disclosure of NH_3 and hydrogen as reducing agents contribute toward suggesting the claim 35 recited substantially selective removal of carbon-containing polymer relative to BPSG and monocrystalline silicon substrate material utilizing a plasma generated from a gas having active components consisting of one or more of O_2 , O_3 , H_2 and NH_3 . Accordingly, independent claim 35 is not rendered obvious by the various cited combinations of Mathews, Allen, Sharan, Brown and Nagashima (with Donohoe being unavailable as a basis for the present rejection). Independent claim 35 is therefore allowable over the art of record.

Dependent claims 36-41 are allowable over the various cited combinations of Mathews, Allen, Sharan, Brown and Nagashima for at least the reason that they depend from allowable base claim 35.

Claims 23 and 24 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mathews as combined with one of Allen or Donohoe in further view of Chen, U.S. Patent No. 5,704,986. Without admission as to the propriety of the Examiner's rejection, claims 23 and 24 are cancelled.

For the reasons discussed above claims 15-22 and 35-41 are allowable. Accordingly, applicant respectfully requests formal allowance of such pending claims in the Examiner's next action.

Respectfully submitted,

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